Green & Blue Roof Guide 2021

Comhairle Cathrach Bhaile Átha Cliath
Dublin City Council

Preface

Why this guide is needed

Dublin City Council (DCC) has introduced a Green Blue Roof Policy as part of the Draft Dublin City Development Plan 2022-2028 (Dublin City Development Plan). The potential of green and blue roofs has been recognised by DCC as a means of delivering against multiple policy objectives relating to flood risk, climate change, amenity and biodiversity, particularly in an inner-city context, where availability of space is limited.

DCC promotes the incorporation of Sustainable Drainage into developments and the use of green blue roofs plays a key role in supporting delivery of a range of policies including SuDS policy SI22.

Who this guide is intended for

This Guide is primarily intended for those designing green blue roofs for new developments within Dublin City. The Guide will also support the planning review process, where green blue roof proposals are assessed by DCC against the Policies and Standards set out in the Dublin City Development Plan.

Applicants should consult this Guide together with Appendix 11 of the Development Plan for guidance on how to comply with Policy SI23, which sets out the requirements for green blue roofs on all new development with roof areas in excess of 100m2.

What the guide provides

This Guide confirms DCC specific requirements in relation to green and blue roofs and expands on how schemes should deliver in accordance with Development Plan Policy SI23.

Readers should note that this Guide provides high level guidance along with signposting other considerations as part of the design process. This Guide should not be viewed as a substitute for more extensive and detailed guidance already available.

Cover: Bord Gais building, Dublin. Denis Byrne Architects. Paul Tierney.

Image right: Dublin green roof. Dusty Gedge

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This guide draws upon the author's 25 years of practical experience in the application of SuDS.

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1.0 Introduction

1.1 Why Green and Blue Roofs are essential for Dublin City

Traditionally Dublin city centre rooftops have been a largely untapped resource populated only by air conditioning units and ventilation shafts. In these high-density urban environments, there are limited opportunities for urban greening, habitat for biodiversity or amenity space. Dublin city is also facing significant challenges from flash flooding and pollution of watercourses from overloaded sewers; coupled with increasing summer temperatures due to climate change and urban heat island effect. We need to tackle these issues to make the city a more pleasant place to live and work.

Roof tops are increasingly being recognised for their potential for amenity use, urban cooling, habitat creation and management of rainfall runoff. The provision of green blue roofs supports many of the Draft Dublin City Development Plan 2022-2028 (Dublin City Development Plan) core policies (see Section 1.3); along with helping to deliver against Dublin City Council (DCC) Climate Action Plan and Biodiversity Action Plan.

Owners are also encouraged to retrofit green and blue roofs onto existing buildings

S123	**Green Blue Roofs** To require all developments with roof areas in excess of 100 sq. metres to provide for a green blue roof in accordance with the requirements of Dublin City Council's Green & Blue Roof Guide (2021) which is summarised in appendix 11.

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1.2 What are Green and Blue Roofs?

Green roofs are roofs or podium decks onto which vegetation is grown, or habitats for wildlife are established. There are various types of green roof including: extensive and intensive roofs, semi-intensive, roof gardens, biodiverse roofs and brown roofs. Green roofs can also be designed to serve an amenity function.

Extensive green roofs are defined by the Green Roof Organisation (GRO), as having a minimum substrate depth of 80mm and 'intensive green roofs' are defined as having a minimum substrate depth of 200mm. Extensive roofs are typically planted with sedums or grass while a less restricted planting palette can be used on intensive roofs. Sedum mats don't provide habitat complexity or vegetation structure.

Brown roofs provide a substrate which is left to self-seed and vegetate.

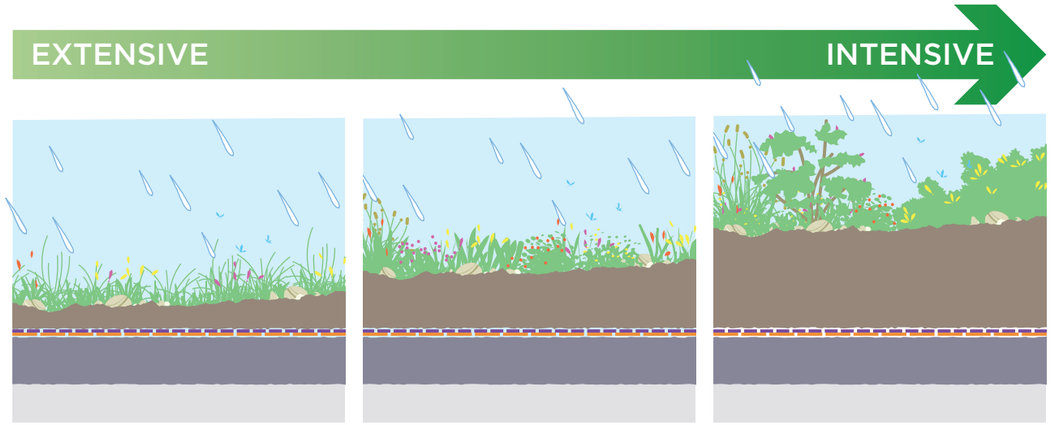
Biosolar green roofs have solar power installations integrated as part of the green roof structure and are designed to maximise biodiversity.

Blue roofs hold rainwater runoff on roofs and podium decks and release rainfall slowly through a 'flow control'. Green blue roofs are simply green roofs with this addition.

Blue roofs do not have to be vegetated and rainfall runoff can be stored within open or closed hard landscape structures on roofs and podium decks. Storing rainwater that falls on the roof provides the potential to reduce or remove the requirement for attenuation storage elsewhere on a proposed development site.

Draft Dublin City Development Plan 2022-2028 Appendix 12 SuDS requirements

Green blue roofs that provide attenuation of rainfall on the roof/ podium deck is the approach preferred by Dublin City Council.



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1.3 The benefits of Green Blue roofs

There are numerous benefits to introducing green blue roofs to a development. Supporting policies are identified within brackets.

Water management (SI22 and SI23) - Green and Blue Roofs protect the receiving sewer system by reducing the rate and volume of runoff when compared with runoff from a conventional flat roof. Green blue roofs have a pronounced effect in dealing with day-to-day rainfall, as the effects of transpiration mean that there is no runoff to the sewer for a significant portion of rainfall events. This is particularly important in the Dublin context where the combined sewers are known to be at capacity with relatively minor amounts of rainfall causing spillages of raw sewage to watercourses.

CFRAM Flood maps for surface water

Air quality (SI34) – Vegetated and soil surfaces which form part of a green roof structure can store carbon and trap air borne pollutants and particulates. Introduction of green roofs will aid Dublin City Council in meeting objectives of the Air Quality Plan.

Air Quality Plan for NO2 in Dublin

Biodiversity (GI16 and GI17) – Green roofs can provide unique opportunities for wildlife in Dublin City, through re-introduction of habitats that have been lost over decades of development. Simple adaptations to standard green roof design can maximise the provision for biodiversity. Significant areas of Dublin City are situated within the Dublin Bay Biosphere transition zone and introduction of biodiverse green roofs will improve opportunities for biodiversity in this area.

Dublin Bay – A UNESCO Biosphere

Urban Cooling (CA8) – Green roofs have been demonstrated to provide heat management effects; both internally within the building (reducing the need for heating and cooling within buildings, therefore reducing carbon emissions) and external ambient air temperatures (reduction in urban heat island effect).

Local Climate Classification and Dublin's Urban Heat Island

Image: Biodiverse green roof. Biophillic Design

Amenity (GI3)– Whilst extensive roofs are not suitable for amenity use, intensive roofs can be designed for this purpose and they can be used as communal and garden space. Green blue roofs can contribute to the requirements of communal open space in residential developments.

Dublin City Development Plan Communal spaces policy

Food production - there is scope for cultivation of edible plants, micro-greens and honey production. This can reduce food miles and climate change impacts as well as increase self-sufficiency and improve health outcomes.

1.4 Misunderstandings associated with green and blue roofs

Numerous misunderstandings and misconceptions have evolved over the years in relation to green and blue roofs which has resulted in designers and developers being wary of using them as a way of managing rainfall runoff.

Some of the perceived barriers include damage to water proofing, significant additional cost, unmanageable maintenance, fire risk and potential incompatibility with PV panels.

There are an extensive number of case studies (see signposts below) across the world and an increasing number of case studies in Ireland robustly challenges these preconceptions. In many cases, not only are the green blue roofs not causing an issue, but they are introducing additional benefits.

London Living Roofs & Walls Report - 2019

Climate ADAPT case study: Basel, Switzerland

SmartCitiesWorld article: Amsterdam installs blue-green roofs

Hamburg City Council: Green Roofs & Green Walls

Minnesota Stormwater Manual: Green roof case studies

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2.0 DCC green blue roof requirements

Technical appendix 11 of the Dublin City Development Plan outlines green blue roof requirements (repeated below).

Green blue roof requirement 1 - applicable development types

All development types are considered appropriate for green blue roof application.

Exemptions

Exemptions will only apply in exceptional circumstances and will be considered by the planning authority on a case-by-case basis.

Residential development will be considered for exemption where there isn't a continuous roof that is centrally managed i.e., the owner of each dwelling is responsible for their own roof. Exemption may also be applicable where the green blue roof is considered to be incompatible with conservation (built heritage) requirements or other over-riding design requirements.

Exemptions will only be granted by DCC where it is demonstrated that suitable provision is made for SuDS measures (in accordance with Dublin City Council Sustainable Drainage Design and Evaluation Guide (2021) and all other planning requirements) and that appropriate sustainable drainage measures can be delivered on the site without the use of a green blue roof.

Green blue roof requirement 2 – area coverage

Planning applications which include roof areas of greater than 100 square metres with flat and gently sloped roofs are considered appropriate for green blue roof application.

The extent of roof area which provides growing medium for vegetation must meet the following coverage requirements as a percentage of total roof area.

Type of green roof	Minimum coverage (% of total roof area being developed)
Extensive	70%
Intensive	50%

The percentage coverage is considered to make a reasonable allowance for the provision of overruns, roof lights, fire breaks, service penetrations and hard landscape.

Exemptions

Where roofs include PV panels, the design should consider the appropriateness of the PV panels being positioned over the vegetated areas of the roof.

Roof areas that are not considered for green roof due to the presence of solar panels should still be considered for blue roof.

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Green blue roof requirement 3 – hydraulic operation

The design of green blue roofs will make provision for suitably sized emergency/ exceedance overflow(s).

Green blue roof requirement 4 – use

The design of the green blue roof should maximise biodiversity and / or amenity benefits.

Green and blue roof designs should be designed to ensure that any amenity use (e.g. use as communal open space) can be facilitated without effecting storage capacity or drainage function of the green blue roof.

Green blue roof requirement 5 - access, operation and maintenance

All green blue roofs shall be designed with consideration of their future maintenance requirements.

Sedums and succulents and soils with low organic content are considered to be naturally fire-retardant and do not present a unique risk to propagating flame spread relative to a conventional flat or gently sloped roof. All green roofs shall be designed in consideration of current fire safety requirements.

Image: Biodiverse green roof. Biophillic Design

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3.0 Design considerations

3.1 Approaching design

It is fundamental that the green and blue roofs provide the drainage function of removing rainfall from the roof. The key difference when compared with a conventional flat or sloping roof is that they do not drain water off the roof as rapidly as they would have in the past.

Green roof design should always be considered from scheme concept design stage. Whilst being best suited to flat roofs, they can be successfully used on sloping roofs. Designers should consider how green and blue roofs integrate into the wider drainage strategy. Key design items to consider at an early stage are:

- Type of green blue roof, with early consideration of maximising opportunities for biodiversity.
- Determining any requirements for amenity – in many parts of Dublin, the rooftop has become a method for delivering public open space.
- Structural requirements and how this might affect building design.
- Likely storage requirements and maximising storage potential on the roof and therefore minimising requirements elsewhere.
- Methods for dealing with exceedance and overflow in managing extreme rainfall.
- Early consideration of maintenance and access requirements and design relative to other roof-level equipment such as mechanical and electrical plant.

3.2 Structural considerations

The additional structural loading of a green blue roof is a key consideration, as there may be an additional cost for strengthening to cope with the extra load.

Early discussions with the project structural engineer are recommended to ensure that the loads can be factored into the overall building design. The structural requirements on the building design to accommodate wind and snow loading may mean the structural requirements to facilitate a green blue roof are relatively small - i.e. it is unlikely to snow heavily and rain within the same time period.

The weight of the green blue roof will depend on a number of factors:

- The maximum depth and volume of water being stored.
- Depth and density of growing medium.
- Weight of the green blue roof assembly.
- The planting used.
- Whether it is being used for amenity purposes, the maximum number of people being facilitated and any amenity features used (paving, seating etc.).
- The structural capacity of the green and blue roof component should be considered for ongoing maintenance and any other activities that may take place on the roof.
- The risk of flotation should be considered in relation to both the insulation layer (inverted blue roof and warm blue roof construction) and potential flotation of the growing medium where water may be temporarily stored above the vegetation layer.

It is anticipated that whether the roof is a green roof or a green blue roof, the structural design should take account of the risk of blockage at the outlet and structural design calculations will consider the maximum depth of water possible above the overflow. The maximum hydrostatic pressure on the parapet should also be considered.

3.3 Hydraulic design

A useful starting point for initiating hydraulic design is to determine the storage volume likely to be available for attenuation. It is not always necessary to store all rainfall events on the roof and smaller return periods such as the 1 in 10 year rainfall return period can usually be catered for with excess rainfall overflowing to the next part of the drainage system.

Ponding within the green roof structure (i.e. backfalls) is not considered acceptable. The only exception is on biodiverse roofs where ponding areas are designed and integrated at the top surface of the green roof.

There are several aspects that need to be considered as part of the hydraulic design:

- Rainfall return period being catered for.
- Area being allocated to green and blue roof as a percentage of the total roof area being drained.
- Number of outlets and where they will be positioned.
- Whether outlets are being designed to control outflow (slow release of rainfall runoff from the roof) or provide unrestricted discharge from the roof.
- The design of overflows should conservatively consider 100% runoff from all areas being drained by the green roof.
- Allowance should also be made for runoff from vertical surfaces draining onto the roof when sizing overflows. 50% of the wall area draining onto the flat roof should be factored into the area calculation for sizing overflows. (No allowance for vertical surfaces is required for attenuation storage calculations)

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Design Considerations

3.4 Calculation of green and blue roof area

When calculating areas of the green roof at early design stage, percentage coverage should make a reasonable allowance for the provision of overruns, parapets, hatches and roof lights, fire breaks, service penetrations and hard landscape. This will ensure that designs will meet the desired percentage as the design develops.

Where roofs include PV panels, the design should consider the appropriateness of the PV panels being positioned over the vegetated areas of the roof. Roof areas that are not considered for green roof should still be considered for blue roof.

3.5 Calculating storage

All types of green roofs will reduce the amount of surface water running off a roof. Green roofs hold on to rainwater in the short term and when the water begins to be slowly released, a proportion will be retained within the plants and soil layer and some rainwater will be released back into the atmosphere via evapotranspiration.

How much water the green roofs will hold will depend on the size and depth of the green roof, the type of plants, and the time of year (plants and the soil layer will experience greater evapotranspiration during the summer months).

Where the green blue roof design meets the requirements of Technical Appendix 11, DCC will consider that the roof area will also meet the requirement of 'Technical Appendix 12 SuDS Requirement 2, Criterion 1.1' for the respective part of the proposed development.

Image: Biodiverse green roof.

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3.6 Estimating available storage volume

In determining available storage volume, consideration must be made of:

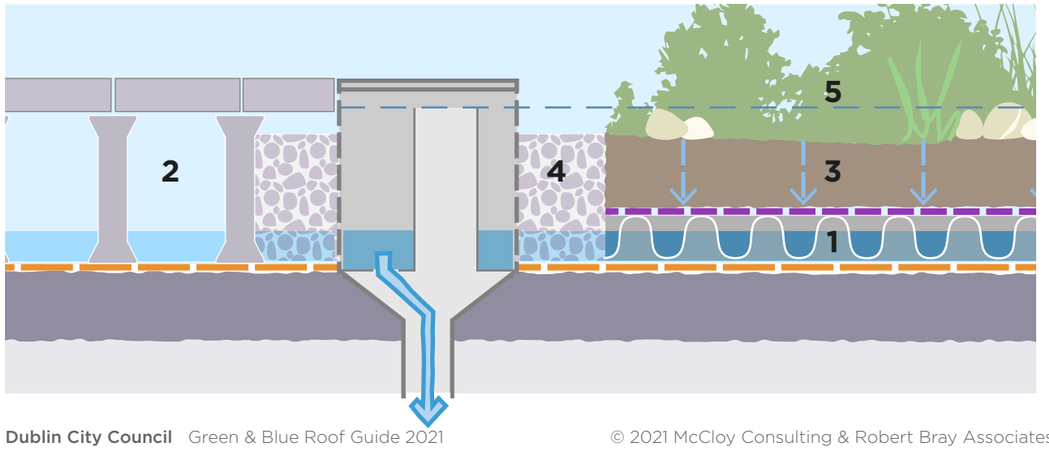
- The materials being used to construct the green blue roof and what percentage of these materials are considered 'void' available for storage.
- The slope of the roof – whilst often referred to as a 'flat roof', a fall across the roof would be expected. Any level variations must be considered in the calculation of available storage volumes.
- When designing for the 1-in-100 year (with 20% climate change allowance) rainfall event, materials can be assumed to be dry with void space available for storage with the exception of reservoirs which should be assumed full.

Designers should not assume 0% fall because a flat roof is specified. It is likely that a fall of between 1-in-40 to 1-in-80 will be used in detailed design and construction to minimise the risk of backfalls and ponding.

Note: Void porosity figures presented below are provided as initial guidance and detailed figures should be informed by manufacturers specification.

1. Drainage board / Reservoirs – assume reservoirs are full for purposes of attenuation storage calculation (50% voids)
2. Storage layer provided by geocellular structures or pedestals – as per manufacturers specification (90-95% voids)
3. Growing medium layer (15-25% voids)
4. Stone (30% voids)
5. Where flows are stored above the vegetation layer (100% voids), the designer should confirm that:
   - the growing medium will not be subject to flotation
   - surface ponding on the roof will only come into effect during extreme rainfall and any ponding will dissipate after a short time period

Typical construction profiles.



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Design Considerations

3.7 Sloping roofs

Where there is a slope on the roof, storage calculations should consider how much storage volume is available within the roof structure.

The roof can be compartmentalised to maximise the storage potential of the roof.

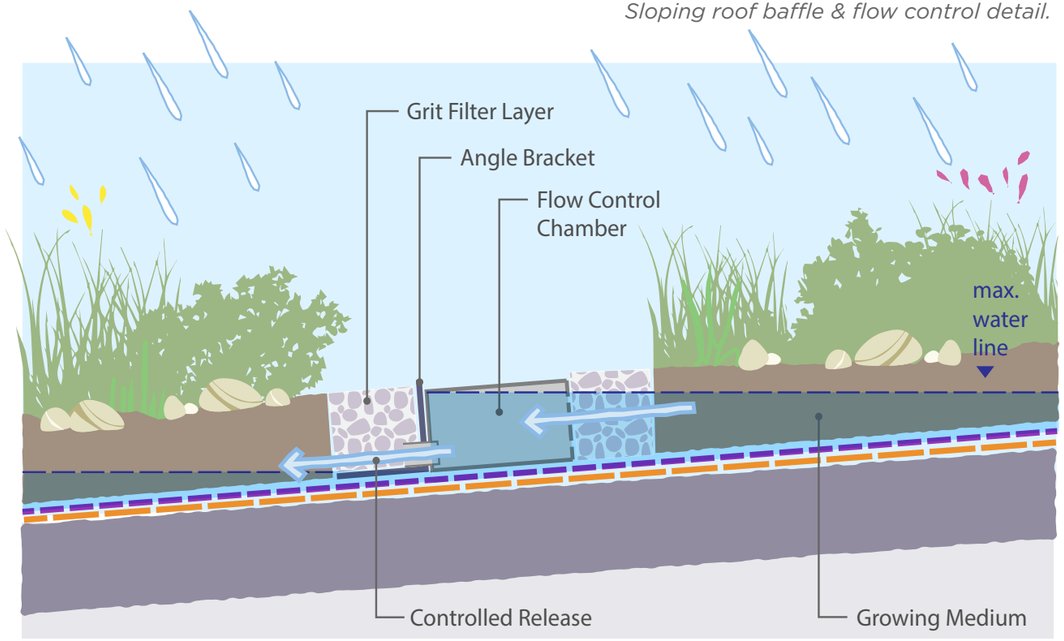
3.8 Allowances for interception losses

CIRIA publications 'C644 Building Greener' and 'C753 The SuDS Manual Table 24.6' detail that 5mm interception losses are expected from green roof constructions. Interception losses will not occur every time it rains. Research indicates that interception of the first 5mm of rainfall would be anticipated for 80% of summer and 50% of winter rainfall events.

The extent of rainfall intercepted will be influenced by various factors including:

- Type of vegetation used - Succulent plant types will retain water and therefore generally will have less capacity to take up water whenever rainfall occurs.
- Antecedent dry period – longer dry periods before rainfall will mean that vegetation, growing medium and drainage reservoirs will have dried out and will have more capacity to take up rainfall.
- Planned regular irrigation of the roof (more likely to happen with intensive or semi-intensive roofs) will mean that the roof will have less capacity to provide significant interception losses.
- Field capacity – deeper growing medium profiles will have greater capacity to intercept runoff.

Sloping roof baffle & flow control detail.



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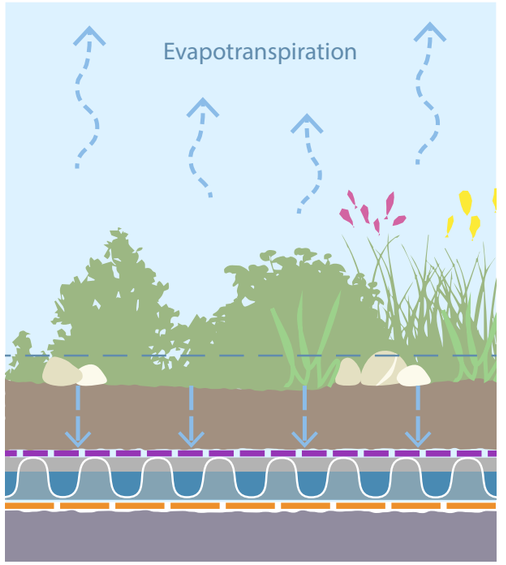

Over recent years Dublin surface water and sewer flood events have frequently coincided with warmer summer months; a season that green infrastructure such as green blue roofs are more likely to have capacity to generate losses from evapotranspiration.

DCC will accept the following reductions in runoff coefficient to allow for the interception losses expected whenever green roofs are incorporated (thus resulting in reduction in storage requirements demonstrated as part of stormwater attenuation calculations).

- Extensive Green Roof – first 5mm of rainfall lost per square meter of Green Roof provided. (Suggested Cv of 0.9)
- Intensive Green Roof – first 10mm of rainfall lost per square meter of Green Roof provided. (Suggested Cv of 0.8).
- Reduction in Cv does not apply to green blue roofs where the growing medium is being used to store runoff.

3.9 Outlets & Flow controls

When sizing outlets from the roof there are two design scenarios to be considered:

- Flow control or free release of flow within normal design parameters.
- Design exceedance or blockage of outlets which will bring overflows into operation.

The number and positioning of roof drainage outlets are likely to be determined by location of low points on the roof or places where outlets can be conveniently connected to lower (ground) levels. The sizing of flow controls will be informed by the number of openings proposed.

A minimum orifice opening size of 10mm is suggested for flow controls. The coefficient of discharge for the orifice opening (or suitable alternative flow restriction mechanism) should be confirmed with the manufacturer.

The designer must demonstrate how the flow control opening is protected from blockage for both green blue roofs and blue roofs, irrespective of flow control opening size.

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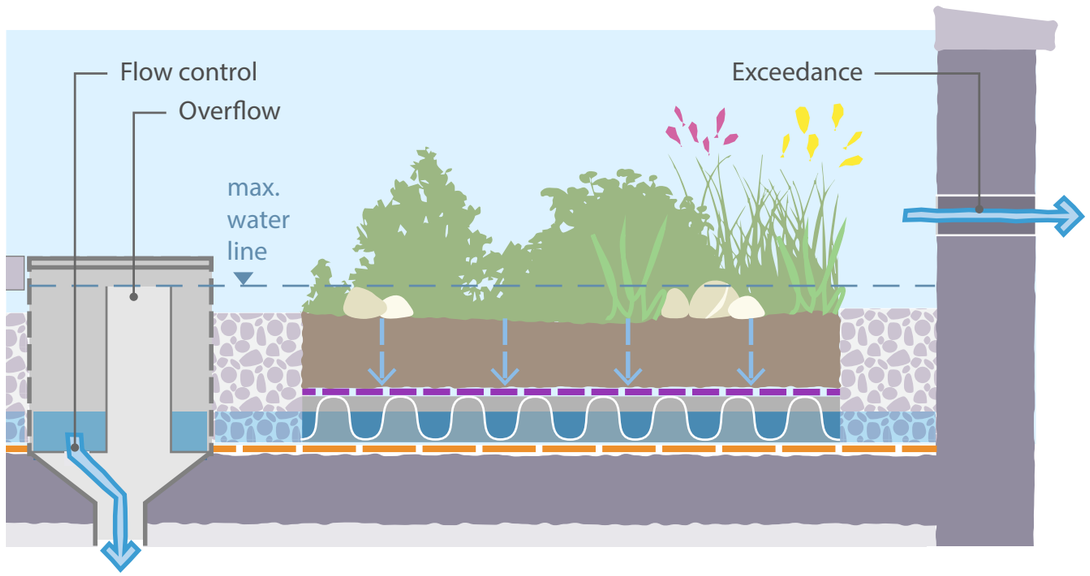
Design Considerations

3.10 Overflows

When designing overflows (location and number of), calculations should assume 100% runoff from all areas being drained by the roof including 50% of the area of any adjacent walls which drain onto the green blue roof.

Example flow control, overflow and exceedance arrangement.



Case study: Sloping green blue roof

The roof layout was compartmentalised to maximise the available storage.

This roof has a 3° pitch which required baffles to attenuate up to the 1-in-30 rainfall event with more extreme event volumes being passed onto and managed in raingardens at ground level. The baffles hold rainfall runoff in each compartment with slow release to the next compartment maximising the storage available across the roof.

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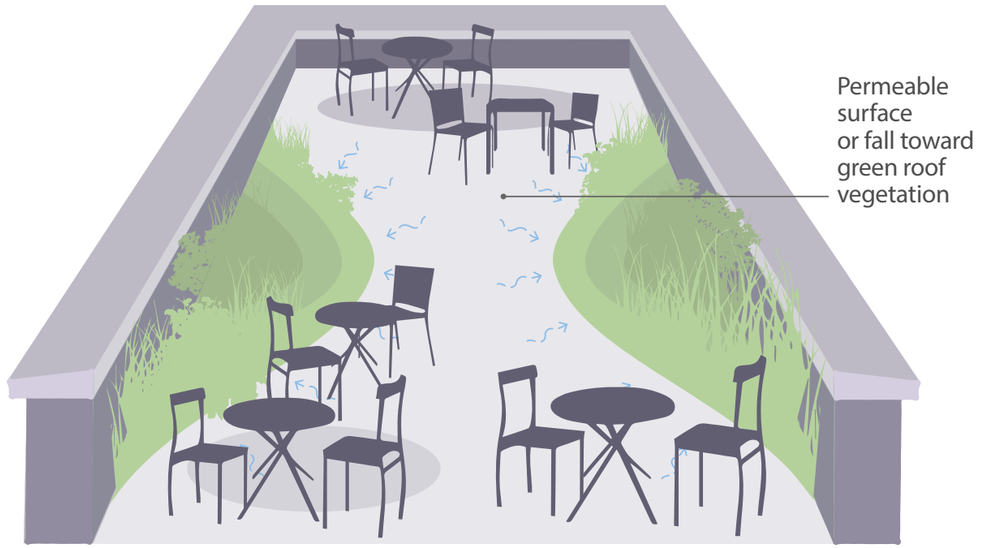
3.11 Using green and blue roofs as communal amenity areas

DCC are currently advising planning applicants of the need to consider roofs areas as potential communal open space under the Apartment Guidelines where there are sunlight deficits at ground level provision. The need to strike a balance between the provision of communal open space and compliance with SuDS and Green Blue Roof policies will be assessed on a case-by-case basis by the Planning Authority and applicants will be encouraged to consult with both the Council's Drainage and Parks Departments prior to submitting their planning application.

When considering blue and green roofs for amenity purposes, there are a few initial considerations to be made in a design context:

- How will people get onto and off the roof?
- Consider choice of plant species for visual aesthetics (in addition to biodiversity contributions).
- Is the vegetation suitable for walking on and if not can the users of the roof be restricted from walking on the vegetation? Areas which cannot take pedestrian activity need to be clearly delineated.
- Are there any other health and safety measures that need to be considered?

When designing blue roofs as a hard landscape amenity space, the use of slabs which can be supported by pedestals, providing storage in the underlying void, should be considered.



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3.12 Maximising habitat potential

Biodiverse green blue roofs have significant potential in a Dublin city setting to offer alternative sites for certain mobile species of fauna which would otherwise be lost through high-density development. Biodiverse green blue roofs provide opportunities for urban dwellers who don't have access to gardens or green space to have some interactions with nature. This is a benefit to human health and well-being.

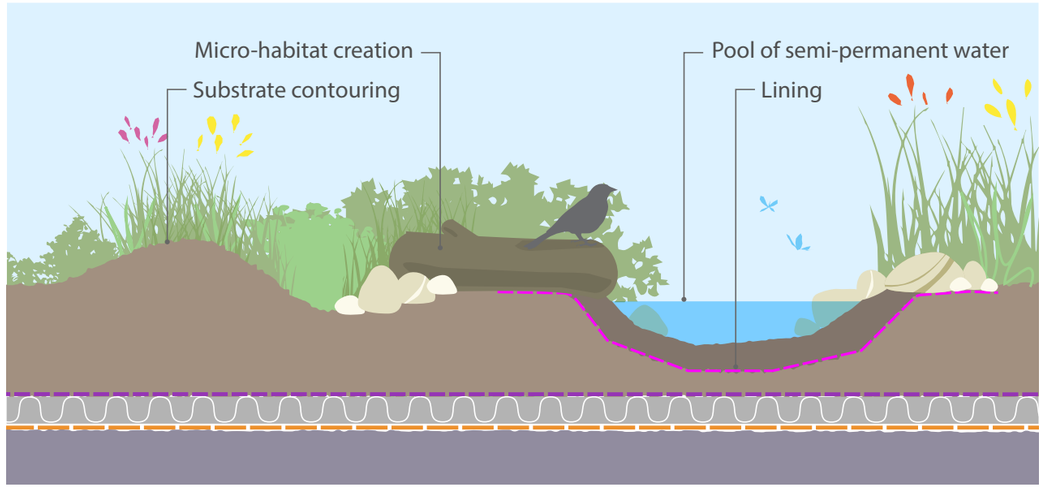
Where material such as gravel or recycled crushed concrete is laid at varying depths to create a diverse topography it can replicate brownfield sites, which often have high biodiversity with rare plant and insect species. Planting should be considered for attraction of aphids and invertebrates, which will provide food sources for an urban bird and bat populations.

Green roofs designed for biodiversity should include:

- A varied substrate depth with mounds and dips.
- Use of logs and rubble to create micro habitats. Log piles can provide areas for shelter and nesting sites for invertebrates such as bees and wasps.
- Roofs can be planted or seeded with a range of native species to attract pollinators such as bees.
- The roof can be left to self-vegetate over time. This may require additional maintenance to ensure that unwanted plant species do not colonise such as Buddleja and Conzya.
- Consideration can be given to creation of small water features through use of liners and contouring of growing medium.

Facing image: Bord Gais building, Dublin. Denis Byrne Architects. Paul Tierney.

Below: Integrating habitat diversity.



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3.13 Plant selection

Where a biodiverse green blue roof is proposed, then a seed mix that replicates Irish grassland habitats, of Irish origin as far as possible, should be specified by a suitably qualified landscape architect or ecologist.

Native Irish seed mixes may be difficult to obtain, and it may be prudent to collect suitable seed on site pre-construction for use. It may be useful to check what is growing on site and in the locality through DCC and National Biodiversity Data Centre records.

Consultation with DCC should be directed to DCC Parks, Biodiversity and Landscape Services and further advice may be sought from the DCC Biodiversity Officer.

Consultation may also be required with the National Parks and Wildlife Service on a case-by-case basis regarding the provenance of seed mixtures, where there is a concern that seeds may disperse from the development site into protected areas.

3.14 Fire safety considerations

Sedums and succulents, and soils with low organic content are considered to be naturally fire-retardant and do not present a unique risk to propagating flame spread relative to a conventional flat or gently sloped roof.

In Germany, where there are millions of square meters of green roof installed, the use of a green roof is considered to provide a protective barrier preventing waterproofing elements from catching fire.

The Green Roof Code provides useful guidance to minimise risk from fire, as follows:

Substrates should have:

- A depth in excess of 80 mm.
- A maximum of 20% organic matter.

Plant selection and management should:

- Include plants such as succulents which retain water within their structure, reducing the risk of drying out.
- Ensure no significant volume of dry material is left on the roof (such as die back from tall grasses and wild flowers at the end of growing season)

Fire breaks should comprise:

- Gravel/shingle strips provided around all structures penetrating the roof covering at least 500mm in width, or 1m in width where they are to act as fire-breaks on large roof areas.
- There should be a 1m wide gravel or slab ‘fire break’ every 40m

Intensive green roof which are irrigated, regularly maintained and have a thick substrate are considered by the Green Roof Code to have no greater fire risk than a conventional roof finish.

Dublin Fire Brigade (DFB) have a preference for no vegetation below PV panels. Where vegetation is proposed below PV panels, DFB should be consulted for their consideration.

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All green roofs shall be designed in adherence of current fire safety requirements. The above advice is intended as initial guidance. Designers should refer to the following documents:

- Approved Document B
- BS 8616:2019 Specification for performance parameters and test methods for green roof substrates
- Fire Performance of Green Roofs and Walls - DCLG UK:2013
- Fire Safety Certificates

3.15 Maintenance considerations

It is important to consider as part of the design process; how people, equipment and material will get on and off the roof.

Safe working platforms and protection against falls should be provided for green and blue roof installation works and systems for safe work should also be available for safe maintenance and operation.

The fall restraint and fall arrest systems should be designed specifically for the maintenance requirements of the green roof system used, with maintenance requirements varying between intensive and extensive roofs.

A maintenance plan should be developed for the green blue roof identifying anticipated tasks and the frequency at which they should be undertaken under the following categories; regular tasks, occasional tasks and remedial tasks.

Safety, Health and Welfare at Work (Construction) Regulations 2013

BS 7887: 2005 - Code of practice for the design, selection, installation, use and maintenance of anchor devices conforming to BS EN 795

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Design Considerations

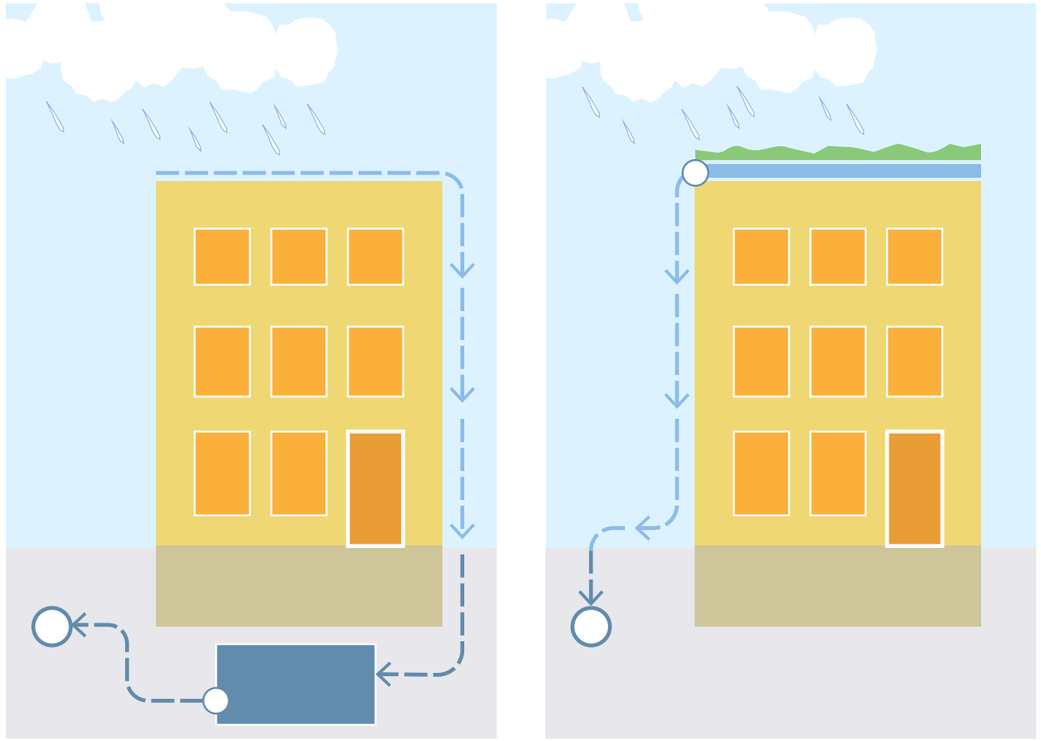
3.16 Cost considerations

Common elements which should come into consideration when considering cost include:

- Additional loading requirements. Where water is stored on the roof this will have a loading requirement. Other loading factors such as wind and snow loading also need to be considered for the structural design of the building. The structural designer will have to consider whether snow loading and storage of rainfall can be considered separately (it does not commonly snow heavily and rain at the same time) or whether these factors have to be considered in combination.
- Potential to offset attenuation storage requirements elsewhere on the site where rainfall runoff is stored directly on the roof.

The diagram below shows how integrating a blue roof can replace the requirement of an attenuation tank under the building with pumped discharge. Utilisation of the roof for attenuation of runoff can result in significant cost savings:

- Potential reduction in energy costs. The insulation properties of green roofs will keep the property warmer in the winter and cooler in the summer. Green roofs can reduce building energy use by 0.7% compared to conventional roofs.



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- Reduction in design life costs. By protecting the roof liner using the green blue roof, the life expectancy of the liner can double .
- Potential maintenance costs. These costs will vary depending upon the type of green blue roof and the types of plants selected.

Case study - London

This building was originally designed to have underground tanks to store the 1-in-100 year rainfall plus climate change.

The quantity surveyor estimated that by changing the design to a blue green roof, where runoff is held at roof level instead, has saved the project costs in the order of €800,000.

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Design Considerations

Further Reading

Dublin City Council - Policies/Strategies/ Masterplans

- Draft Dublin City Development Plan 2022-2028. Specifically the following parts:
  - Chapter 3: Climate Action
  - Chapter 9: Sustainable Environmental Infrastructure and Flood Risk
  - Chapter 10: Green Infrastructure and Recreation
  - Chapter 15: Development Standards
  - Strategic Flood Risk Assessment – Volume 7
  - Appendix 13 - Surface Water Management Guidance.
  - Appendix 12 -Technical Summary of Dublin City Council Sustainable Drainage Design and Evaluation Guide 2021
- Strategic Flood Risk Assessment - Dublin City Development Plan 2022-2028
- Your City Your Space Dublin City Public Realm Strategy
- Dublin City Parks Strategy 2019 – 2022
- Dublin City Council Climate Action Plan 2019 – 2024
- Dublin City Biodiversity Action Plan 2021-2025

Legislation

- Water Framework Directive (2000/60/ EC)
- Planning and Development Act 2000
- Section 7, 12 of the Water Services (No. 2) Act 2013
- European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 S.I. 296 of 2018
- Wildlife (and Amendment) Acts 1976-2012
- Climate Action and Low Carbon Development (Amendment) Act 2021

National/Regional - Policies/ Strategies

- National Development Plan 2021-2030
- OPW Flood Guidelines Planning System and Flood Risk Management Guidelines 2009
- Greater Dublin Strategic Drainage Study 2005 (Regional drainage policies Vol.3)
- The National Climate Change Adaptation Framework, Building Resilience to Climate Change 2012
- The National Climate Change Strategy 2007 – 2012
- National Landscape Strategy for Ireland 2015
- National Climate Action Plan 2019
- National Biodiversity Action Plan 2017– 2021
- 'All Ireland Pollinator Plan' 2015-2020
- National Planning Framework 2018
- Regional Spatial and Economic Strategy for Eastern and Midlands Region 2019
- Water Quality and Water Services Infrastructure Climate Change Sectoral Adaptation Plan 2019
- Flood Risk Management Climate Change Sectoral Adaptation Plan 2019

Applicable Standards/ regulations

- Greater Dublin Regional Code of Practice for Drainage Works
- Building standards - Technical guidance document 2016
- Draft Water Services Guidelines for Planning Authorities 2018

Suggested further guidance

- Green Roof Code of Best Practice UK: 2014.
- The GRO Green Roof Code 2021
- CIRIA Blue Roof Design Guidance (to be published 2022)
- C753 The SuDS Manual (CIRIA 2015)
- C644 Building Greener (CIRIA 2007)
- Fire Performance of Green Roofs and Walls

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Further Reading

Comhairle Cathrach
Bhaile Átha Cliath
Dublin City Council